CLAIMS

1. A superconductive filter module characterized by comprising:

a vacuum heat insulating vessel (2);

a superconductive filter assembly (1) provided in the vacuum heat insulating vessel (2) and composed of a filter housing (21) having a signal input connector (27a) at which a filter input radio frequency signal is inputted and a signal output connector (27b) from which a filter output radio frequency signal is outputted and a columnar resonating member (23) attached to the inner wall (22) of the filter housing (21) at one end thereof (23a) so as to be spaced apart from the signal input connector (27a) and the signal output connector (27b) so that a filter output radio frequency signal component outputted from the signal output connector (27b) selected from the filter input radio frequency signal components inputted through the signal input connector (27a) is brought into a resonance mode in the filter housing (21), the columnar resonating member (23) being coated with a superconductive material (23B) on at least the surface thereof;

a cooling medium (3) provided in the vacuum heat insulating vessel (2) so that the superconductive filter assembly (1) is disposed thereon, and capable of cooling the superconductive filter assembly (1) so that the superconductive filter assembly (1) can be operated under a superconductive state;

a signal input cable (5a) connected to the signal input connector (27a) of the superconductive filter assembly (1) so that a filter input radio frequency signal to be inputted into

the signal input connector (27a) can be transmitted to the inside of the filter assembly (1), the signal input cable (5a) having a heat insulating portion capable of insulating heat conductance into the superconductive filter assembly (1) provided at a proper portion within the vacuum heat insulating vessel (2); and

a signal output cable (5b) connected to the signal output connector (27b) of the superconductive filter assembly (1) so that a filter output radio frequency signal extracted from the signal output connector (27b) can be transmitted to the outside of the filter assembly, the signal output cable (5b) having a heat insulating portion capable of insulating heat conductance into the superconductive filter assembly (1) provided at a proper portion within the vacuum heat insulating vessel (2).

2. A superconductive filter module according to claim 1, characterized in that the columnar resonating member (23) has any of a circular cross-section, an elliptical cross-section or polygonal cross-section.

3. A superconductive filter module according to claim 1, characterized in that each of the filter housing (21) and the columnar resonating member (23) is made of ordinary conductive material, the inner wall (22) of the filter housing (21) and the surface of the columnar resonating member (23) have metal plating (21A, 23A) applied, and a superconductive film (21B, 23B) made of superconductive material is formed on the surface of the metal plating (21A, 23A).

4. A superconductive filter module according to claim 1, characterized in that

the filter housing (21) has on its inner wall (22) a center frequency adjusting member (24) for adjusting the space amount formed between the inner wall (22) of the filter housing (21) and the other end (23b) of the columnar resonating member (23) so as to adjust the coupling capacity between the inner wall (22) of the filter housing (21) and the other end (23b) of the columnar resonating member (23), whereby the center frequency of the filtering frequencies can be adjusted, the surface of the center frequency adjusting member being made of a superconductive material (24B).

5. A superconductive filter module according to claim 4, characterized in that the center frequency adjusting member (24) is made of ordinary conductive material, the surface of the center frequency adjusting member (24) has metal plating (24A) applied, and a superconductive film (24B) made of superconductive material is formed on the surface of the metal plating (24A).

6. A superconductive filter module according to claim 1, characterized in that

a plurality of columnar resonating members (23) are provided with a regular interval interposed therebetween so as to form an array on the inner wall (22) of the filter housing (21), and that

the filter housing (21) has on its inner wall (22) a bandwidth adjusting member (26) for adjusting the space amount formed between the columnar resonating members (23) so as to adjust the coupling capacity between the columnar resonating members (23), whereby the bandwidth of the filtering frequencies can be adjusted, the surface of the bandwidth adjusting member being made of a superconductive material (26B).

7. A superconductive filter module according to claim 6, characterized in that the bandwidth adjusting member (26) is made of ordinary conductive material, the surface of the bandwidth adjusting member (26) has metal plating (26A) applied, and a superconductive film (26B) made of superconductive material is formed on the surface of the metal plating (26A).

8. A superconductive filter module according to any one of claims 3, 5 and 7, characterized in that the ordinary conductive material is either copper type material or nickel type material.

9. A superconductive filter module according to any one of claims 3, 5 and 7, characterized in that the metal plating (21A, 23A, 24A, 26A) is made of any one of silver type material, gold type material or nickel type material.

10. A superconductive filter module according to any one of claims 1 to 10, characterized in that the superconductive material is made of any one of YBCO, NBCO, BSCCO, BSCCO, BPSCCO, HBCCO

and TBCCO.

11. A superconductive filter module according to claim 1, characterized in that the signal input connector (27a) and the signal output connector (27b) have signal coupling units (25a, 25b) provided in the filter housing (21) so as to be opposed to and be spaced apart from the columnar resonating member (23), respectively.

12. A superconductive filter module according to claim 11, characterized in that each of the signal coupling units (25a, 25b) is provided with a signal coupling flat member (40).

13. A superconductive filter module according to claim 11, characterized in that each of the signal coupling units (25a, 25b) is provided with a signal coupling loop member (41).

14. A superconductive filter module according to claim 1, characterized in that

each of the signal input cable (5a) and the signal output cable (5b) is arranged as a heat insulating coaxial cable composed of a center conductor, an insulating member coating the center conductor, and an external conductor provided on the periphery of the insulating member so as to have a heat insulating portion.

15. A superconductive filter module according to claim 14, characterized in that the heat insulating portions are provided

at a plurality of proper positions of the external conductor within the vacuum heat insulating vessel (2).

16. A superconductive filter module according to claim 14, characterized in that the external conductor (103) is arranged to coat the insulating member (102) so that a part of the periphery thereof is exposed, and the insulating member (102) is covered at the exposed peripheral portion with a metal plating (104) as a heat insulating portion having a thickness smaller than the thickness of the external conductor coating the insulating member (102) on the outer periphery thereof.

17. A superconductive filter module according to claim 14, characterized in that the external conductor (113) is arranged to coat the insulating member (112) so that a part of the periphery thereof is exposed, the insulating member (112) is provided at the exposed peripheral portion (115) with an electrostatic capacity element (114) which couples ends of the external conductor coating the insulating member (112) to each other, and the exposed peripheral portion (115) serving as the heat insulating portion.

18. A superconductive filter module according to claim 14, characterized in that the external conductor (123) is arranged to coat the insulating member (122) so that a part of the periphery thereof is exposed, and at the exposed peripheral portion (124) of the insulating member (122), both the opposing ends of the

external conductor coating the insulating member (122) at the periphery thereof are formed into comb-shaped portions and opposed to each other in an interdigitating fashion so that a coupling capacity is created thereat and the opposing external conductor portions formed into the comb-shaped portions serving as the heat insulating portion.

19. A superconductive filter module according to claim 14, characterized in that the external conductor is composed of a metal plating layer (133) coating the insulating member (132) at the outer periphery thereof and a resin layer (134) coating the metal plating layer (133), and at least the metal plating layer (133) also serving as the heat insulating portion.

20. A superconductive filter module according to claim 14, characterized in that the external conductor is arranged as a strap-like conductive member (143) coiling around the outer periphery of the insulating member (142) with a part of the periphery of the insulating member (142) left uncovered, and the strap-like conductive member (143) coiling around the periphery of the insulating member (142) also serving as the heat insulating portion.

21. A superconductive filter module according to claim 14, characterized in that the external conductor is formed into a meander-shaped conductive sheet member (153) coiling around the outer periphery of the insulating member (152) with a part of

the periphery of the insulating member (152) left uncovered, and the meander-shaped conductive sheet member (153) coiling around the periphery of the insulating member (152) also serving as the heat insulating portion.

22. A superconductive filter assembly characterized by comprising:

a filter housing (21);

a signal input connector (27a) attached to the filter housing (21) and connectable to a signal input cable (5a) for transmitting a filter input radio frequency signal;

a signal output connector (27b) attached to the filter housing (21) at a position different from the position at which the signal input connector (27a) is attached, and connectable to a signal output cable (5b) for transmitting a filter output radio frequency signal; and

a columnar resonating member (23) attached on the inner wall (22) of the filter housing (21) at one end thereof (23a) so as to be spaced apart from the signal input connector (27a) and the signal output connector (27b) so that a filter output radio frequency signal component selected from the filter input radio frequency signal components is brought into a resonance mode in the filter housing (21), the columnar resonating member being coated with a superconductive material (23B) on at least the surface thereof.

23. A superconductive filter assembly according to claim 22,

characterized in that the columnar resonating member (23) has any of a circular cross-section, an elliptical cross-section or polygonal cross-section.

24. A superconductive filter assembly according to claim 22, characterized in that each of the filter housing (21) and the columnar resonating member (23) are made of ordinary conductive material, the inner wall (22) of the filter housing (21) and the surface of the columnar resonating member (23) have metal plating (21A, 23A) applied, and a superconductive film (21B, 23B) made of superconductive material is formed on the surface of the metal plating (21A, 23A).

25. A superconductive filter assembly according to claim 22, characterized in that

the filter housing (21) has on its inner wall (22) a center frequency adjusting member (24) for adjusting the space amount formed between the inner wall (22) of the filter housing (21) and the other end (23b) of the columnar resonating member (23) so as to adjust the coupling capacity between the inner wall (22) of the filter housing (21) and the other end (23b) of the columnar resonating member (23), whereby the center frequency of the filtering frequencies can be adjusted, the surface of the center frequency adjusting member being made of a superconductive material (24B).

26. A superconductive filter assembly according to claim 25,

characterized in that the center frequency adjusting member (24) is made of ordinary conductive material, the surface of the center frequency adjusting member (24) has metal plating (24A) applied, and a superconductive film (24B) made of superconductive material is formed on the surface of the metal plating (24A).

27. A superconductive filter assembly according to claim 22, characterized in that

a plurality of columnar resonating members (23) are provided with a regular interval interposed therebetween so as to form an array on the inner wall (22) of the filter housing (21), and that

the filter housing (21) has on its inner wall (22) a bandwidth adjusting member (26) for adjusting the space amount between the columnar resonating members (23) so as to adjust the coupling capacity between the columnar resonating members (23), whereby the bandwidth of the filtering frequencies can be adjusted, the surface of the bandwidth adjusting member being made of a superconductive material (26B).

28. A superconductive filter assembly according to claim 27, characterized in that the bandwidth adjusting member (26) is made of ordinary conductive material, the surface of the bandwidth adjusting member (26) has metal plating (26A) applied, and a superconductive film (26B) made of superconductive material is formed on the surface of the metal plating (26A).

29. A superconductive filter assembly according to any one of claims 24, 26 and 28, characterized in that the ordinary conductive material is either copper type material or nickel type material.

30. A superconductive filter assembly according to any one of claims 24, 26 and 28, characterized in that the metal plating (21A, 23A, 24A, 26A) is made of any one of silver type material, gold type material or nickel type material.

31. A superconductive filter assembly according to any one of claims 22 to 30, characterized in that the superconductive material is made of any one of YBCO, NBCO, BSCCO, BSCCO, BPSCCO, HBCCO and TBCCO.

32. A superconductive filter assembly according to claim 22, characterized in that the signal input connector (27a) and the signal output connector (27b) have respective signal coupling units (25a, 25b) provided in the filter housing (21) so as to be opposed to and be spaced apart from the columnar resonating member (23), respectively.

33. A superconductive filter assembly according to claim 32, characterized in that each of the signal coupling units (25a, 25b) is provided with a respective signal coupling flat member (40).

34. A superconductive filter assembly according to claim 32, characterized in that each of the signal coupling units (25a,

25b) is provided with a signal coupling loop member (41).

35. A heat insulating type coaxial cable for use with a superconductive filter assembly including a filter housing (21) having a signal input connector (27a) at which a filter input radio frequency signal is inputted and a signal output connector (27b) from which a filter output radio frequency signal is outputted, and a columnar resonating member (23) coated with a superconductive material (23B) on at least the surface thereof so as to bring into a resonance mode in the filter housing (21), a filter output radio frequency signal component outputted from the signal output connector (27b) selected from the filter input radio frequency signal components inputted through the signal input connector (27a), the coaxial cable (5a, 5b) being connectable to the signal input connector (27a) or the signal output connector (27b), the heat insulating type coaxial cable characterized by comprising:

a center conductor;

an insulating member coating the center conductor; and

an external conductor attached to the outer periphery of the insulating member and provided at a proper position thereof with a heat insulating portion capable of insulating heat from being conducted into the superconductive filter assembly.

36. A heat insulating type coaxial cable according to claim 35, characterized in that the heat insulating portions are provided at a plurality of proper positions of the external conductor.

37. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor (103) is arranged to coat the insulating member (102) so that a part of the periphery thereof is exposed, and the insulating member (102) is covered at the exposed peripheral portion with a metal plating (104) as a heat insulating portion having a thickness smaller than the thickness of the external conductor coating the insulating member (102) on the outer periphery thereof.

38. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor (113) is arranged to coat the insulating member (112) so that a part of the periphery thereof is exposed, the insulating member (112) is provided at the exposed peripheral portion (115) with an electrostatic capacity element (114) which couples ends of the external conductor coating the insulating member (112) to each other, and the exposed periphery portion (115) serving as the heat insulating portion.

39. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor (123) is arranged to coat the insulating member (122) so that a part of the periphery thereof is exposed, and at the exposed peripheral portion (124) of the insulating member (122), both the opposing ends of the external conductor coating the insulating member (122) at the periphery thereof are formed into comb-shaped portions and

opposed to each other in an interdigitating fashion so that a coupling capacity is created thereat and the opposing external conductor portions formed into the comb-shaped portions serving as the heat insulating portion.

40. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor is composed of a metal plating layer (133) coating the insulating member (132) at the periphery thereof and a resin layer (134) coating the metal plating layer (133), and at least the metal plating layer (133) also serving as the heat insulating portion.

41. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor is arranged as a strap-like conductive member (143) coiling around the periphery of the insulating member (142) with a part of the outer periphery of the insulating member (142) left uncovered, and the strap-like conductive member (143) coiling around the periphery of the insulating member (142) also serving as the heat insulating portion.

42. A heat insulating type coaxial cable according to claim 35, characterized in that the external conductor is formed into a meander-shaped conductive sheet member (153) coiling around the periphery of the insulating member (152) with a part of the outer periphery of the insulating member (152) left uncovered, and the meander-shaped conductive sheet member (153) coiling around

the periphery of the insulating member (152) also serving as the heat insulating portion.

43. A heat insulating type coaxial cable connectable to a superconductive device at least one composing element of which is operated under a superconductive state, characterized by comprising:

a center conductor;

an insulating member coating the center conductor; and

an external conductor attached to the outer periphery of the insulating member and provided at a proper position thereof with a heat insulating portion capable of insulating heat from being conducted into the superconductive filter assembly.